



Symmetry 2015

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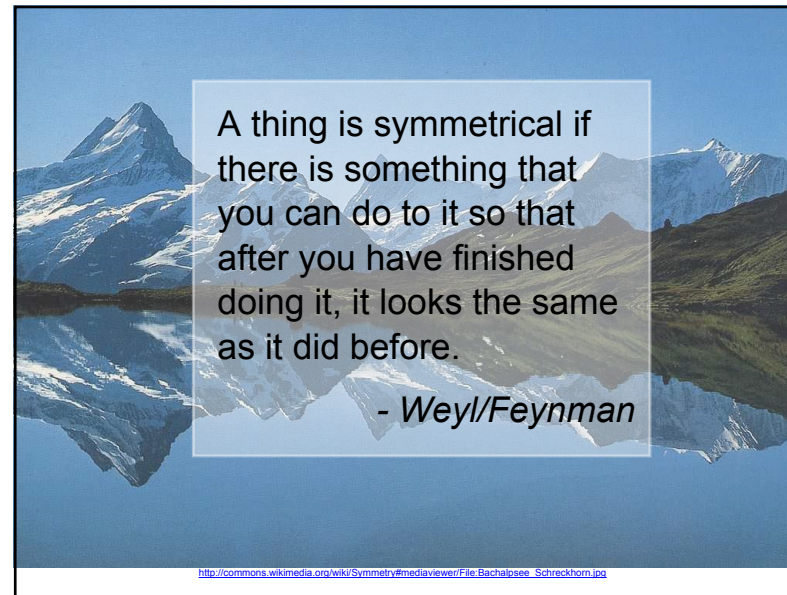
Mathematics is much more than finding sums, differences, products, and quotients. Mathematics is a way of looking at the world. As a mathematician, you view the world looking for regularity and order or the lack of order and regularity.



Hyogo prefectural Tajima dome in Hidaka-cho
http://commons.wikimedia.org/wiki/File:Tajima_Dome_Hyogo201.jpg

The Peace Tower dominates the Centre Block structure of the Canadian Parliament buildings.
 W. Lloyd MacKenzie, via Flickr @ http://www.flickr.com/photos/saffron_blaze/

Mar 30-7:58 PM



A thing is symmetrical if there is something that you can do to it so that after you have finished doing it, it looks the same as it did before.

- Weyl/Feynman

http://commons.wikimedia.org/wiki/Symmetry#mediaviewer/File:Bachalpsee_Schreckhorn.jpg

Jan 20-1:43 PM


Symmetry: Symmetry Is All Around You!

We are surrounded by all types of symmetry a type of regularity and order--in nature, in architecture, in art and much more. Look carefully at the world around you. Did you know that there are THREE types of symmetry? The picture of the sea flower to the left possesses all three types of symmetry.

LINE SYMMETRY: The most common type of symmetry is **line symmetry**. A figure that can be folded in such a way that one-half of it lies exactly on the other half is said to have **line symmetry**.

ROTATIONAL SYMMETRY: A figure is said to have **rotational symmetry** if there exists a point around which the figure can be rotated less than one complete turn of 360 degrees in order to result in an identical figure.

POINT SYMMETRY: A figure is said to have **point symmetry** if it can be rotated one-half of a turn or 180 degrees about a point onto itself. After learning about these three types of symmetry you will begin to notice all of the **symmetry** in your world. Enjoy its beauty and the interest that it adds to your environment.



Mar 30-7:58 PM

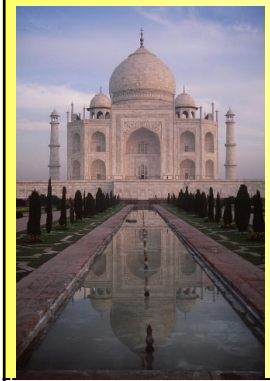
Symmetry All Around You

Line Symmetry

Line Symmetry is also known as **Bilateral Symmetry**

We are surrounded by all types of **symmetry** a type of regularity and order--in nature, in architecture, in art and much more.

The most common type of **symmetry** is **line or bilateral symmetry**. A figure that can be folded in such a way that one-half of it lies exactly on the other half is said to have **line symmetry**. The two parts of the original pictures are mirror images of each other and are said to be congruent. [Congruent means that both parts have the same shape and the same size.] Look closely at the picture of the Taj Mahal of the left. Can you find where the line of symmetry is in this picture?



Back to Symmetry

Explore these pages for activities and more information about LINE symmetry!

Line Symmetry or Not?	Pattern Blocks	Letters
Activities	Extensions	Challenge

Line Symmetry

Sort Line Symmetry

Has Line Symmetry | Not Line Symmetry

Line Symmetry Home | Line Symmetry or Not? | Pattern Blocks
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Sort Line Symmetry

Symmetry: Pattern Blocks and Line Symmetry

Let's look at the pattern blocks below. Find all of the different lines of symmetry for each pattern block. Pull out the pull tabs to check your answers.

Line Symmetry Home | Line Symmetry or Not? | Pattern Blocks
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Pattern Blocks

Symmetry: Letters and Line Symmetry

Which capital letters have line symmetry?

A B C D E F G H I
J K L M N O P Q R
S T U V W X Y Z

Have you ever stopped to think about the symmetry of the capital letters? For example, the letter A has line symmetry but the letter F does not. Draw the lines of symmetry for the letters above if any exist. Circle the letters that do NOT have line symmetry.

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Letters

Lines of Symmetry

Answers

Letters with line symmetry
A, B, C, D, E, H, I, M, O, T, U, V, W, X, Y

Letters without line symmetry
F, G, J, K, L, N, P, Q, R, S, Z

• Did you find all the letters with line symmetry?
• Do some letters have more than one line of symmetry?
• Does the font style have anything to do with the lines of symmetry? Explain.

Line Symmetry Home | Line Symmetry or Not? | Pattern Blocks
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Letters - answers

Symmetry: Activities in Line Symmetry



1. Make a picture that has line symmetry, tell how many lines of symmetry it has, and draw them on the picture.
2. Make a picture that DOES NOT have line symmetry. Explain how you know.

Line Symmetry Home Line Symmetry or Not? Pattern Blocks
Letters Activities Extensions Challenge

Activities - Line Symmetry

Symmetry: Extension Activities

1. Think of a beautiful butterfly. Butterflies have **line symmetry**. Find other things in nature that have **line symmetry** and draw it, cut the picture out of a magazine, or take a photo of it.
2. Find an object in your house with **line symmetry** and draw it, cut the picture out of a magazine, or take a photo of it.
3. Find something with exactly one **line of symmetry** and draw it, cut the picture out of a magazine, or take a photo of it.
4. Can you find something with an infinite number of **lines of symmetry**? If so, what is it?



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Extensions - Line Symmetry

Symmetry: Challenge Problem

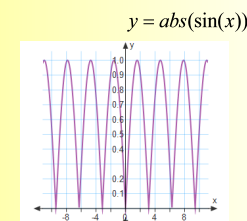
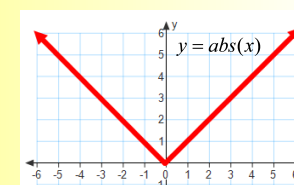
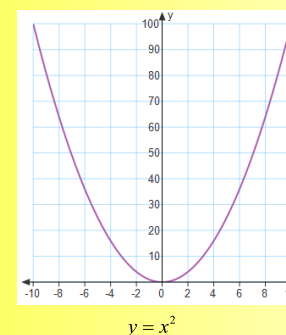


Using what you know about line symmetry, fold and cut a piece of paper to make a chain of paper dolls - girls, boys, animals, etc.

Line Symmetry Home Line Symmetry or Not? Pattern Blocks
Letters Activities Extensions Challenge

Challenge - Line Symmetry

Graphs of functions with line symmetry



Nov 15-10:18 AM

Reflections with matrices!



Video on Matrix Transformations

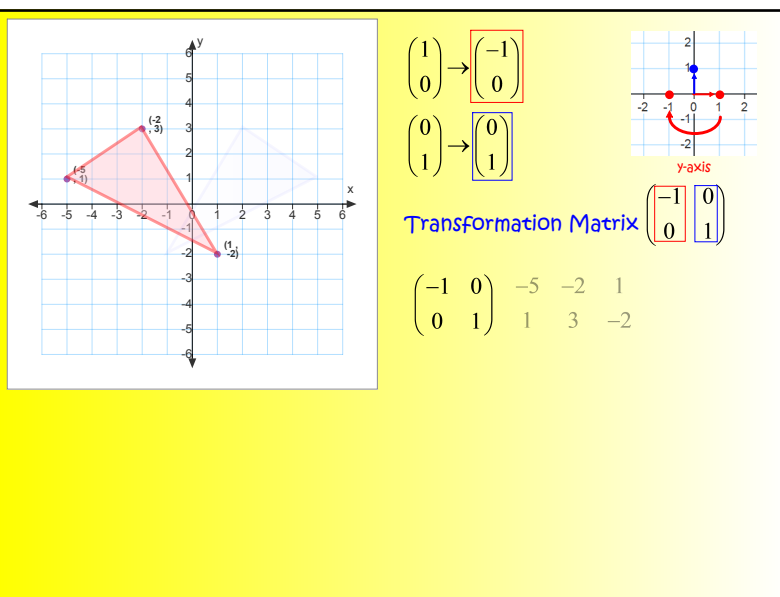
Nov 14-12:43 AM

Let's Review...

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} e & f \\ g & h \end{bmatrix} = \begin{bmatrix} ae+bg & af+bh \\ ce+dg & cf+dh \end{bmatrix}$$

Watch the Matrix Multiplication Video and listen to the song!
<http://www.youtube.com/watch?v=BGbiHdKHG7o>

Nov 15-9:51 AM



Nov 15-7:40 AM

Symmetry All Around You - Rotational Symmetry

Rotational Symmetry is also known as **Radial Symmetry**.

We are surrounded by all types of **symmetry**, a type of regularity and order—in nature, in architecture, in art and much more.



It is common to find objects with **rotational symmetry**. A figure can be turned about a point less than 360 degrees and land on an image of itself is said to have **rotational symmetry**. Another way of thinking of rotational symmetry is seeing an image arranged in rays diverging from a single point. That point is called the **center of rotation**.

The pinwheel has **rotational symmetry**. The point in the middle of the pinwheel is the **center of rotation**. If you ignore the colors and focus only on the shape, the pinwheel has an **order** of 7 and **magnitude** of 360/7 or 51 3/7 degrees. The **order** is found by determining how many stops you can make while turning in a circle matching the original image. The **magnitude** is found by dividing 360 degrees by the **order**.

Explore these pages for activities and more information about



Rotational symmetry

Rotational Symmetry or Not?

Pattern Blocks

Hub Caps

Activities

Extensions

Rotational Symmetry

















Edit

Check

Reset

Solve

?

Rotational Symmetry	No Rotational Symmetry
       	       

Rotational Symmetry Home

Pattern Blocks

Hub Caps

Activities

Extensions

Challenge

Rotational Symmetry or Not?


Sort Rotational Symmetry

Symmetry: Pattern Blocks and Rotational Symmetry

Let's take a look at the pattern blocks below. Find all of the pattern blocks with **rotational symmetry**. (Each can be rotated to test it.) If it has **rotational symmetry**,


- put a dot on the **Center of Rotation** and mark it "C"
- write its **order** and
- write its **magnitude**.

If you want to check your answers, click on the rectangle to reveal them.




order = _____
mag = _____

Answer




order = _____
mag = _____

order = 2 mag = 180°
Answer




order = _____
mag = _____

Answer



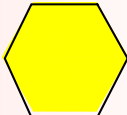
order = _____
mag = _____

Answer



order = _____
mag = _____

Answer



order = _____
mag = _____

Answer

Rotational Symmetry Home

Pattern Blocks

Hub Caps













Activities

Extensions

Pattern Blocks

Symmetry:

Hub Caps and Rotational Symmetry

Hub Cap				
Order				
Magnitude				

A good source of objects that have **rotational symmetry** happen to be hub caps. Have you noticed? Take a look at the four hub caps above. All have **rotational symmetry**. Now it's your turn. See if you can give the order of each and their magnitudes and when you're done, check them.

Take a look at cars and see what other kinds of hubcaps possess **rotational symmetry**. Can you find any hub caps that don't have **rotational symmetry**?

Rotational Symmetry Home

Rotational Symmetry or Not?

Pattern Blocks

Hub Caps

Activities

Extensions


Hub Caps

Symmetry:

Activity in Rotational Symmetry

a. Make a picture that has **rotational symmetry** and its order and magnitude.

b. Make a picture that **DOES NOT** have line symmetry but has **rotational symmetry**.



Rotational Symmetry Home	Rotational Symmetry or Not?	
Pattern Blocks	Hub Caps	Activities
		Extensions

Activities - Rotational

Symmetry: Extension Activities in Rotational Symmetry

a) Can you find other things in nature that have rotational symmetry and draw it, cut the phot out of a magazine, or take a photo of it. Take a look at the cross-sections of fruits, vegetables, or plants. Do they have rotational symmetry?



b) Find some toys or sports equipment with rotational symmetry. Draw them, cut photos out of a magazine, or take a photo of them.

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Extension - Rotational

Symmetry: Challenge Problem



Using what you know about **rotational symmetry** can you **fold and cut** a figure that has **rotational symmetry** with an **odd order**?

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Challenge - Rotational

Symmetry All Around You - Point Symmetry

The symmetry that is the least talked about is **point symmetry** even though it can be spotted everywhere in the world around you. **Point symmetry** is a special subset of **rotational symmetry**. In other words, any figure that has **point symmetry** automatically has **rotational symmetry**. However, any figure with **rotational symmetry** may or may not have **point symmetry**.



A figure that can be turned about a point 180° and land on an image of itself is said to have **point symmetry** and rotational symmetry of order 2. Another way to check for **point symmetry** is to turn it upside down (180°) and see if it looks exactly the same. The picture of the volleyball has **point symmetry**. It has **rotational symmetry** of order 2 and **magnitude of 180°** and so it also has **point symmetry**.

When you are looking at the examples on the next page of **point symmetry** find the **order** of rotation for the figures with and without **point symmetry** to see if you can find the pattern.

Explore these pages for activities and more information about **point symmetry**.

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[Challenge](#)

Point Symmetry

Edit
Check
Reset
Solve
?

Point Symmetry				No Point Symmetry			

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Sort Point Symmetry

Symmetry: Pattern Blocks and Point Symmetry

Let's take a look at the pattern blocks below. Find all of the pattern blocks with **point symmetry**. If it has **rotational symmetry**, write its order and magnitude.

What is true of the order of objects with **point symmetry**?

Pattern Block	Point Symmetry?	Order?	Magnitude?

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Pattern Blocks - Point

Symmetry: Playing Cards and Point Symmetry

In a standard deck of playing cards, which cards have **point symmetry**?

Make a list and name both the suit and the cards with and without **point symmetry**.

Be careful... Some are tricky.

Ace of diamonds does have **point symmetry**. **Ace of hearts** does not have **point symmetry**.

why?

Do all diamonds have **point symmetry**?

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Cards - Point Symmetry

Symmetry: Playing cards and Point Symmetry

These cards have **point symmetry**. Why is this true and what is the order/magnitude of each? Are there any surprises?

See the other cards - the [cards with NO Point Symmetry](#).

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Cards with point symmetry

These cards do NOT have **point symmetry**. Why don't they? Were there any surprises? Explain

Press to Reveal

Press to Reveal

Press to Reveal

Before you finish with your deck of cards, turn the cards over and take a look.

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Cards without point symmetry

Lots of Symmetry!
When you first looked at a deck of cards I would guess that you didn't realize all of the symmetry it had to share with you. These designs are pretty detailed. Which have **POINT symmetry**? Which have **ROTATIONAL Symmetry**? Which have **LINE symmetry**?

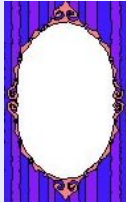


Point Symmetry Home **Point Symmetry or Not?** Pattern Blocks
Deck of Cards Activities Extensions Challenge

Card designs

Symmetry: Activities in Rotational Symmetry

This picture has both **point** and **rotational** symmetry of order 2.



a. Draw a picture with **point symmetry** and **rotational symmetry** of order 2.


b. Make a picture that DOES NOT have **point symmetry** but DOES have **rotational symmetry**.

c. If an image has **rotational symmetry**, how can you quickly tell if it has **point symmetry**? Can you find a rule for the **order** and/or **magnitude** of a figure that will guarantee an object that has **rotational symmetry** will also have **point symmetry**?

Point Symmetry Home **Point Symmetry or Not?** Pattern Blocks
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Activity - Point Symmetry


Symmetry: Extension Problems



1. Many plants have point symmetry. this one lives under water and is called a seaflower. Can you find other things in nature with point symmetry? Draw them, cut a picture out of magazine, or take photos of them.

2. Find an object in your house with point symmetry. Draw them, cut a picture out of magazine, or take photos of them.


3. This is a picture of a face of an old compass. Are there other historical treasures that have point symmetry. You'll have to search in many places to find some of these.



Point Symmetry Home **Point Symmetry or Not?** Pattern Blocks
Deck of Cards Activities Extensions Challenge

Extension - Point Symmetry

Symmetry: Challenge Problem



Using what you know about **point symmetry**, can you fold and cut out a piece of paper to make a figure with **point symmetry** - like this one?

Point Symmetry Home **Point Symmetry or Not?** Pattern Blocks
Deck of Cards Activities Extensions Challenge

Challenge - Point Symmetry

Construct a Sierpinski Triangle - Fractals and Symmetry

1. Draw a LARGE triangle on your paper.
2. Using a ruler or compass, find the midpoints of each side.
3. Connect the midpoints with 3 line segments.
4. Shade or color the new triangle that is surrounded by the other new triangles.
5. How many new triangles did you create?
6. Do you notice anything interesting about the original triangle and the new triangles? about the new triangles?
7. For each of the non-shaded new triangles repeat steps 2-4, creating an iteration!

QUESTIONS:

1. Do all Sierpinski triangles have line symmetry? Explain.
2. Do Sierpinski triangles have rotational symmetry? Explain.
3. Are there any Sierpinski triangles with point symmetry? Explain.

Sierpinski 1
Sierpinski 2
Sierpinski 3

Construct Sierpinski



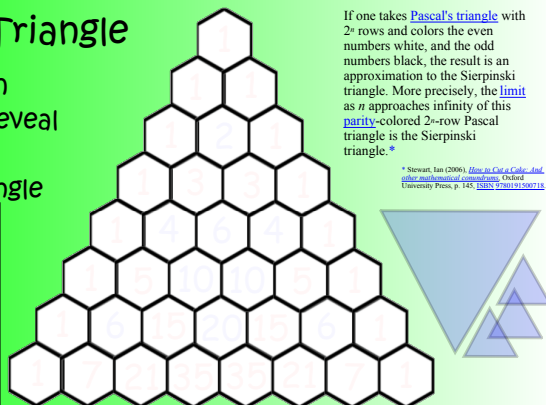
Sierpinski Fractal in 3-D video

Sierpinski video

Pascal's Triangle

Click on each
hexagon to reveal
the value in
Pascal's Triangle

Move to reveal
a picture of the
Sierpinski
Triangle



If one takes Pascal's triangle with 2^n rows and colors the even numbers white, and the odd numbers black, the result is an approximation to the Sierpinski triangle. More precisely, the limit as n approaches infinity of this parity-colored 2^n -row Pascal triangle is the Sierpinski triangle.*

* Stewart, Ian (2006). *How do Computers Work*. Oxford University Press, p. 145. ISBN 0-19-530711-6

Pascal's Triangle

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